CMWR 2008 STUDENT FELLOW AWARDEE

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TITLE: Reactive Percolation using Pore-Network Modeling

ABSTRACT:

Paper Description :

Dissolution and deposition modeling is crucial to ensure geological CO2 sequestration. In carbonate reservoirs particularly, the CO2-induced acidification causes the matrix dissolution near the wellbore. The ionic species may further reprecipitate and form deposition layers, either because of incompatible water mixing, or due to variations in thermodynamic conditions. Consequently, the potential permeability decrease could reduce the economically accessible volume and ultimately lead to the project rejection.

The aim of this work is to develop a numerical tool, based on pore-network modeling (PNM), that describes the effects of a reactive flow on transport properties and structure evolution at the core scale. The model is based on the resolution of the macroscopic convection-dispersion equation for a reactive solute. Its coefficients, namely apparent volumetric reactive coefficient, mean solute velocity and dispersive coefficient, are analytically calculated, for each unit cell of the network, by solving microscopic equations and using upscaling techniques. The deposit location and thickness and their impact on petrophysical properties (permeability-porosity relationships) are determined as functions of rock characteristics and reactive flow regimes.

Results :

It has been observed, numerically and experimentally within glass micromodels, that the deposit map depends both on microscopic and macroscopic scales through relevant dimensionless numbers, Peclet and Damköhler, defined at the appropiate scale. Depending on the values of these numbers, the deposition occurs, at pore scale, either uniformly, in throats or in pores, whereas, at core scale, it takes place along the main flow paths or uniformly. It was found that the corresponding K-Φ laws are different from the Cozeny-Karman law that is usually used in reservoir simulators. A such arbitrary function is deficient to describe dissolution-deposition phenomena.
The main advantage of this work is to provide constitutive K-Φ laws, based on a physical description, to be used as input in reservoir simulators to enhance CO2-storage performance predictivity.